2018-00493 - Service Problems within Highly Dynamic Distributed Systems

Level of qualifications required: Graduate degree or equivalent
Fonction: PhD Position

Context

The availability of wireless communications has drastically increased in recent years and established new applications. Humans, agents, devices, robots, and applications interact together through more and more heterogeneous infrastructures, such as mobile ad hoc networks (MANET), vehicular networks (VANET), (mobile) sensor and actuator networks (SAN), body area networks (BAN), as well as always evolving network infrastructures on the Internet. In such networks, items (users, links, equipments, etc.) may join, leave, or move inside the network at unforeseeable times.

The dynamics of such networks, the heterogeneity of devices, usages, and participants, and often the unprecedented scale to consider, make the design of such infrastructures extremely challenging. For a vast majority of them, the dynamics are also unpredictable. Furthermore, designing applications on top of such networks requires to deal with the lack (or weakness) of infrastructures and numerous topological changes.

Therefore, it becomes necessary to define and to develop new accurate models capturing the features of the considered objects: users’ mobility, system instability, dynamics of applications, etc. Recently, numerous models (refer to [1,2,3], [4] for a survey) for these harsh environments have been gathered in a general framework: the Time-Varying Graphs (TVGs) [5]. Based on this framework, DELYS team recently proposed a quite thoroughgoing study of fixed point problems (like maximal matching, minimal dominating set, maximal dominating set, etc.) in highly dynamic systems [6,7,8]. In particular, some necessary and sufficient topological conditions are exhibited for these problems.

Assignment

The main goal of the thesis is to provide a similar study about problems without fixed point in highly dynamic systems. Such problems refer to service tasks that are priori unpredictably triggered on demand by some participants. We propose to focus on one of the following fundamental problems: Mutual Exclusion, Token Circulation, or Propagation of Information with Feedback. All this problems received great attention in static systems but have barely been considered in the context of highly dynamic systems.

Main activities

The scientific agenda is mainly threefold:
- First, studying service problems in the context of TVG with the goal to provide a specification that makes sense in highly dynamic systems;
- Producing necessary and sufficient conditions on the system (e.g., network dynamic, network topology, etc.) to enable existence of solutions to this specification in highly dynamic systems;
- The design of distributed algorithms that meet these necessary and sufficient conditions in order to

obtain optimal solutions (with respect to impossibility results)

Skills
A PhD grant is available at Sorbonne University. Located on the Pierre and Marie Curie campus (4, place Jussieu, Paris), the position is open for three years starting in autumn 2018.

The position is offered to students who hold a Master degree in Computer science, and are interested in theory of distributed computing. A solid knowledge in algorithms, synchronization, concurrency, and fault-tolerance will be appreciated.

To apply, please provide the following information:

- A resume or Curriculum Vitae;
- A list of courses and grades of the last two years of study;
- Names and contact details of three references (people who can recommend you), whom we will contact directly.

Benefits package
- Subsidised catering service
- Partially-reimbursed public transport
- Flexible working hours